DOCUMENT RESUME

ED 191 692 SE 031 776

AUTHOR Kelner, Bernard G.: Hofkin, Fred M.
TITLE Key Competencies, Science Education: Secondary Schools (Junior High, J-G Sci) (Senior High, S-Bio).
INSTITUTION Philadelphia School District, Pa. Office of Curriculum and Instruction.
PUB DATE 80
NOTE 63p.: For related document, see SE 031 775.

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Behavioral Objectives: Biology: *Board of Education Policy: Competency Based Education: General Science: Junior High Schools: *Science Curriculum: Science Education: *Science Instruction: Secondary Education: *Secondary School Science

ABSTRACT

Presented is a list of behavioral objectives which can be used to evaluate mastery of the competency of students in junior high school science and senior high school biology. These competencies were prepared by the School District of Philadelphia. The lists are comprehensive and coded for easy reference. (CS)

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KEY COMPETENCIES

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SCIENCE EDUCATION: SECONDARY SCHOOLS

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Division of Science Education

Key Competencies

SCIENCE EDUCATION
(Junior High)
(J-G Sci)

and

SCIENCE EDUCATION
(Senior High)
(S-Bio)

Bernard G. Kelner
Associate Superintendent
Curriculum and Instruction

Fred M. Hofkin
Director
Science Education

1980

AUG 4 1980

THE SCHOOL DISTRICT OF PHILADELPHIA
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BERNARD G. KELNER
Associate Superintendent
Curriculum and Instruction
Phone: 299-7767

File #200
June 2, 1980

Dear Colleagues:

The School District of Philadelphia is committed to quality education for all its students. In this regard, two recent events are of particular significance: the Board of Education resolution reaffirming the use of mandated curricula and the Superintendent's "Blueprint for Academic Achievement." All schools, unless receiving official approval to do otherwise, are to use the School District's courses of study; all students are to be considered as having high potential.

The "Blueprint" calls for the identification of essential learning for each grade. To assist principals and teachers, the Office of Curriculum and Instruction has prepared "Key Competencies" for the mandated subjects. With each competency are behavioral objectives which can be used to evaluate mastery of the competency. The lists are comprehensive and coded for easy reference. Each publication contains the sequence of competencies for either elementary or secondary subjects thus providing a perspective of learning over a period of time. Copies are being distributed to all personnel directly involved with instruction.

It should be noted that the term *key competency* signifies the opening of the door to learning. In no way should mastery of these competencies be considered the limit of education. The courses of study provide a full array of content and activities. On the other hand, failure to master the key competencies should be a signal for intensive evaluation of the effectiveness of the educational program - a process calling for collaborative effort of school, home, and if need be, community.

A curriculum publication is, by its very nature, always in a state of development. Your review of this document is eagerly sought and your recommendations will be deeply appreciated. Please send your comments to me. I am as close to you as your phone.

With every good wish.

BERNARD G. KELNER
Associate Superintendent
Curriculum and Instruction

BGK/ar

SCIENCE EDUCATION

The major goal of science education is to develop scientifically literate and concerned individuals with a high competence for rational thought and action. This goal is based on the belief that achieving scientific literacy involves the development of attitudes, process skills, and concepts necessary to meet the more general goals of all education, such as:

a. learning how to attack new problems, how to acquire new knowledge.
b. using rational processes.
c. building competence in basic skills.
d. developing intellectual and vocational competence.
e. exploring values in new experiences.
f. understanding concepts and generalizations.
g. learning to live harmoniously within the biosphere.

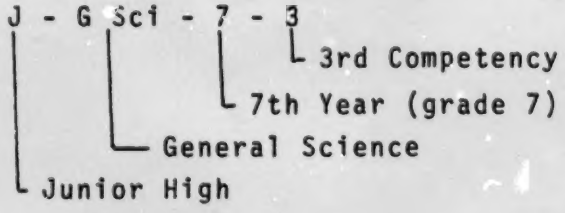
Above all, science education develops in the individual an ability to learn under one's own initiative.

The scope of the science program is for grades kindergarten through twelve.

The booklet will treat the key competencies in the secondary program (grades seven through twelve).

The following coding system was used to designate the competencies:

Example A:



01 - Student Outcome 1
02 - Student Outcome 2
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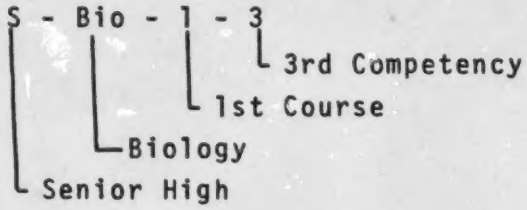
Example B:



01 - Student Outcome 1

02 - Student Outcome 2

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Note: The following courses are given in the secondary program:

J - G Sci - 7	-	General Science (7th Year)
J - G Sci - 8	-	General Science (8th Year)
S - Bio - 1	-	Biology (Usually 9th or 10th Year)
S - Phys - 1	-	Physics (Usually 11th or 12th Year)
S - Chem - 1	-	Chemistry (Usually 10th, 11th or 12th Year)

For further information regarding science education, its curriculum and services, please refer to Curriculum Means Service or contact:

Dr. Fred M. Hofkin, Director
Division of Science Education
Administration Building
Parkway at 21st St. - Rm. 305
Philadelphia, PA 19103

Phone: 299-7771

GENERAL SCIENCE
(J-G Sci-7)

Key Competencies

Grade 7

J-G Sci-7-1 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF, AND SKILLS RELATED TO, LIFE IN FRESH WATER HABITATS:

01. List factors needed for the production of algae.

02. State the limits of environmental factors needed for the production of algae.

03. Understand limiting factors by culturing a sample of algae.

04. Describe why algae are plants and, like terrestrial plants, respond to the same environmental factors.

05. Contrast the similarities and the differences between the algae (plant) and the daphnia (animal).

06. Identify the major parts of the microscope and state the function of each part.

07. Prepare a slide of algae culture.

08. Focus a microscope and locate algae organisms.

09. Conduct a population survey of the organisms within a micropond system.

10. Construct an organism histogram.

11. Plan and conduct controlled experiments to determine the interrelationships between plants and animals.

12. State causes for decreases and increases in population counts over a given period of time.

13. Construct a diagram to show population interdependence within the community.

Grade 7

J-G Sci-7-1 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF AND SKILLS RELATED TO LIFE IN FRESH WATER HABITATS (continued):

14. Predict and verify through experimentation the effect of herbicides on populations within a given community.

15. Demonstrate an understanding of community interdependence by labeling each organism as a consumer, producer or scavenger, and charting the food chain based upon these organisms.

J-G Sci-7-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF LIFE IN MARINE HABITATS:

01. Plan and conduct a controlled experiment showing fresh water organism reactions in salt water.

02. Demonstrate their knowledge of the independence of ocean tidal pool inhabitants by diagraming a typical food chain that exists in a tidal pool.

03. Write a report including the work of American aquanauts on their exploration of the oceans.

J-G Sci-7-3 STUDENTS WILL DEMONSTRATE UNDERSTANDING AND SKILLS RELATED TO LIFE IN LAND HABITATS:

01. Chart data resulting from a controlled experiment concerning temperature range for optimum growth of plants.

02. Predict and verify an indirect relationship between temperature and plant growth as a result of the experiment.

03. Make additional inferences about the relationship of climate, producers, and consumers while comparing world climate maps with world population maps.

04. Examine plant structures and predict the type of climate needed for plant survival.

05. Verify the above by planning and conducting a controlled experiment for plant survival.

Grade 7

J-G Sci-7-4 STUDENTS WILL DEMONSTRATE UNDERSTANDING AND SKILLS RELATED TO MODIFYING THE ENVIRONMENT:

01. Identify those areas (soil, water, air) which have been polluted.

02. List the most common pollutants that have been introduced into the environment.

03. Identify the pollution problems in the student's immediate environment, school, community, and city.

04. Plan and conduct an activity to help solve one of the pollution problems in the immediate environment.

05. State what has been done to solve the more wide-spread causes of pollution.

06. Construct a cause and effect chart of the effects various pollutants have had on particular organisms in the environment.

07. Compare a list of endangered organisms to a list of human environmental alterations.

08. Identify what has been done to counteract the effects of pollution.

J-G Sci-7-5 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF LIFE FUNCTIONS:

01. Define each process as to its function and purpose in sustaining life.

02. State how each metabolic process is interrelated.

03. List the major parts of each of the body systems.

04. Design and conduct an experiment to compare heart rate, breathing rate, and exercise.

05. Determine the caloric intake for a single day and compare it to the number of calories consumed by various activities.

Grade 7

J-G Sci-7-5 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF LIFE FUNCTIONS (continued):

06. Compare daily caloric intake with what is required for the age/height, and make recommendations for balancing intake.

07. Conduct and report findings on an investigation into the term "junk food".

08. Identify those body parts that show relatively quick growth.

09. Compare those body parts that regenerate quickly to those that take a longer period of time.

10. Plan and conduct a controlled experiment to determine if a growth stimulant (like plant food) aids in the production of new cells as represented by increased growth.

11. Compare those parts of the human body that regenerate, and those that do not, to the regenerative powers of lower class animals.

12. Explain the purpose regeneration serves in lower and higher forms of animal life.

13. Describe how living things respond to animal stimuli.

14. Compare reproductive processes of plants vs. animal organisms.

15. Compare and contrast an organism's reproductive processes with its mobility, range, and world-wide numbers.

16. Compare the life cycles of a yet untested organism to that of one already observed.

17. Use data to predict the biotic potential of an organism.

18. Compare the second or third generation to the first generation of various types of seeds.

Grade 7

J-G Sci-7-5 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF LIFE FUNCTIONS (continued):

19. Identify those characteristics present in both parent and offspring.

20. Research and list human traits that are present in their families.

21. Construct a flow schematic to show dominant and recessive traits in offspring.

22. Discuss the social implications of genetic engineering.

J-G Sci-7-6 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO THE CELL-BASIC UNIT OF STRUCTURE:

01. Identify the basic parts of a plant cell and an animal cell, and state the function of each part.

02. State and demonstrate the necessary requirements for microscope slide construction.

03. Prepare wet and dry mount slides of various organism parts.

04. Diagram and label the major cell parts and their function.

05. Group various cell pictures as being muscle, nerve, or epidermal.

06. Identify the special needs of muscle, nerve, and epidermal cells respectively.

07. Sketch and construct models of muscle, nerve, and epidermal cells including appropriate labels.

08. Describe the nature of cancer in respect to cell growth and current measures of treatment.

09. Identify the types of tissues associated with the major organs of the body.

10. State that the major organs are specialized groups of tissues.

Grade 7

J-G Sci-7-6 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO THE CELL—BASIC UNIT OF STRUCTURE (continued):

11. Construct a flow chart illustrating the progression from individual cell to tissue, to organ, to system.

12. Illustrate and label each of the body systems individually and jointly.

13. Identify several community systems which are similar to our body systems.

14. Draw an analogy between the interdependence of the body systems and those systems present in our modern world.

J-G Sci-7-7 STUDENTS WILL DEMONSTRATE SKILLS AND KNOWLEDGE RELATED TO THE WORLD OF CELLS:

01. State the difference between protoplasm and cytoplasm.

02. Plan and conduct an experiment to demonstrate the presence of water in protoplasm.

03. Plan and conduct experiments to determine the effect of an increase or decrease in the concentration of nutrients on living organisms.

04. Compare diffusion in air to diffusion in water.

05. Predict and verify the effect of prolonged water immersion on the human body.

06. Predict and verify the effect of the root hair alterations on the growth of plants.

07. Identify the areas of the human body wherein diffusion occurs.

08. Plan and conduct an experiment to demonstrate the principle of osmosis.

09. Predict and verify the results of an experiment involving the consumption of CO_2 and production of O_2 by elodea.

Grade 7

J-G Sci-7-7 STUDENTS WILL DEMONSTRATE SKILLS AND KNOWLEDGE RELATED TO THE WORLD OF CELLS (continued):

10. Diagram the transmission of materials from the root system of a plant to the outer extremities.

11. Order the amount of energy needed to perform various physical exercises;i.e., "which exercise requires the most energy?"

12. Write a report which links hormonal imbalance with its effect upon the human body.

13. Identify major human hormones and how they are used in body functions.

J-G Sci-7-8 STUDENTS WILL DEMONSTRATE SKILLS AND KNOWLEDGE OF MICROSCOPIC PLANTS:

01. Present evidence that algae are the most numerous organisms on earth.

02. Construct food webs using algae as primary source.

03. Compile lists of commercial foods containing algae.

04. Diagram and label main types of bacteria.

05. Design and carry out experiments to test factors for bacterial growth.

06. State the function and uses of helpful bacteria.

07. Relate bacterial diseases with the bacteria-causing agent and eradication methods.

08. Diagram yeast cells and reproduction by budding.

09. Explain the uses of yeast in the baking industry.

10. Compare microscopic observations of molds and spores with textbook illustrations.

11. Explain the positive and negative aspects of molds in industry and everyday life.

Grade 7

J-G Sci-7-9 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO PLANTS WITHOUT SEEDS:

01. Compare algae and fungi.

02. Explain reproduction in mushrooms.

03. Compare parts of mosses and liverworts to parts of seed plants.

04. Diagram reproduction of mosses.

05. Calculate the amount of water twenty grams of mosses can hold.

06. Explain cellular structure of ferns.

07. Diagram the life cycle of a fern.

08. Report from library research on the ancient fern forest as fossil coal producers.

J-G Sci-7-10 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF SEED PLANTS:

01. Diagram, identify, and give function of seed parts.

02. Design experiments to test germination of seed parts.

03. Design controlled experiments to test the effect of environmental factors.

04. Construct posters and experiments showing the function of roots, stems, and leaves.

05. Determine the age and growth qualities of a tree by examining its annual rings.

06. Illustrate carbon dioxide-oxygen cycle of plants and animals.

07. Illustrate and conduct experiments to show that photosynthesis is carried on in the leaf.

08. Diagram the process of photosynthesis.

Grade 7

J-G Sci-7-10 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF SEED PLANTS (continued):

09. Diagram and explain the function of the parts of a flower.

10. Explain pollination and the role of insects in it.

11. Diagram steps leading to fertilization.

12. Trace the development of parts of the fruit or flower.

13. Diagram the life cycles of seed plants.

J-G Sci-7-11 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF MICROSCOPIC ANIMALS:

01. Illustrate and describe the structure and food-getting habits of four protozoa.

02. Use the microscope in studying protozoa.

03. Explain reproduction of protozoa by fusion and spores.

04. Prepare a report on disease caused by protozoa.

J-G Sci-7-12 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO ANIMALS WITHOUT BACKBONES:

01. List in order of complexity the six groups of animals without backbones and name at least two animals for each group.

02. Describe the characteristics of each group.

03 Compare food-getting processes of the simple invertebrates with those of the more complex.

04. Explain complete and incomplete metamorphosis.

05. Illustrate the life cycles of insects that undergo complete and incomplete metamorphosis.

Grade 7

J-G Sci-7-12 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO ANIMALS WITHOUT BACKBONES (continued):

06. Identify the group of invertebrates that outnumber all other animals.

07. Prepare a report to show one of the following: harmful and helpful insects, insect controls, social insects, or insect habitats.

08. List various types of mollusks and their habitats.

J-G Sci-7-13 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF VERTEBRATE ANIMALS:

01. Compare the fish and the seal to distinguish the simpler and more complex aquatic vertebrates.

02. Contrast the vertebrate and invertebrate skeleton.

03. Describe characteristics of amphibians including structure, metamorphosis, food-getting, and survival techniques.

04. Describe structure, movement, and food-getting of reptiles.

05. Construct a diaroma or chart of prehistoric reptiles.

06. Prepare a report on one of the following topics: poisonous reptiles, dinosaur, tropical lizards, Galapagos Island tortoises, or alligators as endangered species.

07. State the characteristics of birds that distinguish them from the other vertebrates.

08. Compare flight adaptations of birds to aircraft design.

09. Describe beak and foot adaptations of different kinds of birds.

10. Trace the migrating route of one migrating bird.

Grade 7

J-G Sci-7-13 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF VERTEBRATE ANIMALS (continued):

11. Predict the kind of bird that is best adapted to a given habitat.

12. State the characteristics of mammals.

13. Distinguish between warm-blooded and cold-blooded animals.

14. Design and conduct experiments to test breathing rates with various activities.

15. List actions that indicate the greater intelligence of mammals.

16. Compile a list of different groups of mammals under their special characteristics.

17. Construct food webs to show the interdependence of living things.

J-G Sci-7-14 STUDENTS WILL DEMONSTRATE SKILLS AND KNOWLEDGE OF GEOLOGY:

01. Name, describe, and illustrate the three parts of the lithosphere.

02. Construct a model of the lithosphere.

03. Present at least two theories of how the earth was formed.

04. State the origin and properties of igneous, sedimentary, and metamorphic rocks.

05. Classify rocks according to their physical properties.

06. Identify common rocks found in Philadelphia and Delaware Valley.

07. Identify the uses of rocks as building materials.

Grade 7

J-G Sci-7-14 STUDENTS WILL DEMONSTRATE SKILLS AND KNOWLEDGE OF GEOLOGY (continued):

08. Identify the rocks which are appropriate for certain environments.

09. Present a simple explanation of plate techtonics.

10. Locate major faults in the earth's crust and compare with earthquake locations.

11. Diagram volcanic eruption.

12. Identify fossil fuels and their major locations on earth.

13. Prepare a report on the finiteness of fossil fuels.

J-G Sci-7-15 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO THE LITHOSPHERE:

01. State the composition and properties of water and some of its uses related to the lithosphere.

02. Illustrate the water cycle.

03. List the fresh and salt water bodies of the world.

04. Describe the properties of ocean water.

05. Compare the topography of the lithosphere with that of the ocean floor.

06. Describe the changes in the earth's surface above and below the oceans.

07. Present research reports on the methods used to study the oceans.

Grade 7

J-G Sci-7-16 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS IN DEALING WITH METEOROLOGY:

01. State and describe the properties of air.

02. Name the gases composing the air and state the accepted percentages of each.

03. Describe the interactive forces that produce our weather, i.e. heating, evaporation, and pressure.

04. Identify instruments used to measure air pressure.

05. Name the major air pollutants and the prevention methods being used.

06. Identify the weather instruments and the factors they measure.

07. Use a thermometer to measure and record temperature on the Celsius scale.

08. Measure and record relative humidity.

09. Use a standard sky chart as data for weather prediction.

10. Identify symbols of a weather map and use data for weather prediction.

11. Construct at least one weather instrument.

J-G Sci-7-17 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO ASTRONOMY:

01. Present theories on the origin of the universe to show the uncertainty of knowledge.

02. State the characteristics and members of our solar system.

03. Name the easily observed stars and constellations of our summer and winter skies.

Grade 7

J-G Sci-7-17 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO ASTRONOMY (continued):

04. Explain the importance of Polaris, its location, and the circumpolar stars.

05. State how planetary distances are measured and give some examples of the vastness of our universe.

06. Describe motion in terms of location, direction, and reference points.

07. Describe the earth's motions and the relationship to time and the seasons.

08. Describe the physical characteristics of the sun.

09. Present evidence that the sun is the source of all the earth's energy.

10. Diagram the basic structure of solar heating and compare this with other forms.

11. Present research on space exploration including future possibilities.

GENERAL SCIENCE

(J-G Sci-8)

Key Competencies

Grade 8

J-G Sci-8-1 STUDENTS WILL DEMONSTRATE SKILLS AND KNOWLEDGE RELATED TO PROPERTIES OF MATTER:

01. Compare colors of substances with a spectrum.

02. Conduct flame tests to identify substances by their characteristic colors.

03. Identify substances by characteristic odor or taste.

04. Use a hardness scale to order substances as another identification tool.

05. Identify an unknown substance by its distinguishable sensory properties.

06. Use a laboratory balance to mass common objects in kilograms and grams.

07. Use a given volume of various fluids.

08. Use a spring scale to measure the weights of common objects.

09. Describe the difference between a beam balance and a spring scale.

10. Present examples of inertia in their daily lives.

11. State and demonstrate the characteristics of each phase of matter, solid, liquid, gas.

12. Calculate the volumes of regular solids.

13. Measure volumes of liquids using a graduated cylinder.

14. Demonstrate the displacement of measuring irregular and grandular solids.

15. Demonstrate the conservation of matter as it changes from one phase to another.

16. Demonstrate the effect of heat and pressure on changes of phase of matter.

Grade 8

J-G Sci-8-1 STUDENTS WILL DEMONSTRATE SKILLS AND KNOWLEDGE RELATED TO PROPERTIES OF MATTER (continued):

17. Calculate the density of a given volume of a substance.

18. Compare the densities of equal sized solids.

19. Construct a density column using at least three liquids and three objects.

20. Use a hydrometer to find the specific gravity of common liquids.

21. Present examples of the uses of elasticity and malleability in their daily lives.

22. Use criteria for physical and chemical changes of matter to distinguish when each has occurred.

23. Apply the principle of the Conservation of Matter to physical and chemical changes.

24. Present examples of physical and chemical changes in their everyday lives.

J-G Sci-8-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF MIXTURES AND COMPOUNDS:

01. Select and demonstrate techniques for separating parts of given mixture.

02. Devise methods for separating mixtures found in daily life.

03. Use the separation processes to demonstrate the conservation of matter.

04. Identify the solutes and solvents in various mixtures or models of mixtures.

05. Distinguish various kinds of solutions.

06. List common solvents and their uses in early living.

07. Use a graph to communicate comparative solubilities of given solutes in water and other solvents.

Grade 8

J-G Sci-8-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF MIXTURES AND COMPOUNDS (continued):

08. Distinguish the properties of solutions from non-solutions.

09. Classify common household mixtures as solutions or non-solutions.

10. Demonstrate the preparation of dilute, concentrated, and saturated solutions.

11. List household solutions that are purchased concentrated but are diluted before being used.

12. Use saturated solutions for crystal formation.

13. Identify substances by solubility.

14. Demonstrate the effect of temperature on solubility and crystal formation.

15. Distinguish by properties those mixtures that are suspensions or emulsions.

16. Identify the components of the oxidation process.

17. Distinguish between slow and rapid oxidation.

18. Explain spontaneous combustion and relate this to fire prevention.

19. List common oxides and their uses.

20. Identify acids by their distinguishable properties.

21. Devise test procedures for identifying acids.

22. Prepare a report on the uses of an acid in industry.

23. Identify bases by their distinguishable properties.

24. Devise test procedures for identifying bases.

Grade 8

J-G Sci-8-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF MIXTURES AND COMPOUNDS (continued):

25. Compare tests of acids and bases.

26. Use one or more of the tests to classify common foods as acids or bases.

27. Demonstrate the reactions of neutralization using dilute acids and bases.

28. Name the products of the neutralization reactions from a list of acids and bases.

29. Write simple formulas for common salts.

30. List salts found in the home.

31. List the uses of salts in various industries.

J-G Sci-8-3 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF MOLECULES AND CHEMICAL CHANGE:

01. Distinguish the properties of gas molecules as similar atoms and compounds.

02. Distinguish the properties of gas molecules as dissimilar atoms.

03. Illustrate the arrangement of atoms in diatomic gases and write their formulas.

04. Construct models and write the formulas for simple compounds.

05. Demonstrate the test for identifying oxygen and hydrogen when separated from a compound.

06. Redefine a chemical change based on the separation of molecules into atoms, as the combination of different atoms.

07. Use experimental data to explain that substances react and decompose in constant proportions.

08. Contrast the properties of compounds with those of the elements of which they are composed.

Grade 8

J-G Sci-8-3 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF MOLECULES AND CHEMICAL CHANGE (continued):

09. Demonstrate chemical changes induced by electrical, heat, and light energy.

10. Use experimental data to illustrate that molecules have space between them and are in constant motion.

11. Measure temperature change and relate this to increased speed of molecules.

12. Use experimental data to demonstrate surface tension and cohesion of molecules.

13. Illustrate the arrangement of atoms and write the formulas for the diatomic molecules.

J-G Sci-8-4 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF THE CHEMICAL ELEMENTS:

01. Name and write symbols for at least twenty common elements.

02. State the uses of at least twenty common elements.

03. Compare the properties of elements with those of the compounds of which they are composed.

04. Construct a circle graph to show the proportion of elements in the earth's crust.

05. Distinguish between the chemical and physical properties of elements using oxygen as a reference.

06. Classify a group of displayed elements as metals or non-metals.

07. Retrieve information and make predictions from the periodic chart of the elements.

Grade 8

J-G Sci-8-4 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF THE CHEMICAL ELEMENTS (continued):

08. Demonstrate the hierarchy of mixtures, compounds, and elements to show that the element cannot be decomposed into another substance.

09. Explain the structure of the simplest atom, hydrogen.

10. Compare the model of an atom with a drawing of the solar system.

11. Construct models of simple atoms labelling nuclei, protons, neutrons, and electrons.

J-G Sci-8-5 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO FORCE, WORK, AND ENERGY:

01. Describe and give examples of the forces that cause motion.

02. Explain and give examples of friction and gravity as related to motion.

03. Define weight as it relates to gravity.

04. Demonstrate the use of platform balances and spring scales.

05. State and express mathematically Newton's laws of motion.

06. Identify examples of the application of the laws of motion.

07. State and express mathematically the definition of work.

08. Explain how friction, gravity, and inertia are resistance forces to work.

09. Give examples of simple machines and how they operate.

Grade 8

J-G Sci-8-5 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO FORCE, WORK AND ENERGY (continued):

10. Define energy in terms of work.

11. Define and give examples of potential and kinetic energy systems and their conversions.

12. List the major forms of energy and give examples of how they are converted from potential to kinetic.

13. Name the fossil fuels and their major locations on earth.

14. Describe ways of recycling and conserving our nonrenewable resources.

15. Present a report on recent advances in technology that use renewable resources or are a major improvement in the use of nonrenewable ones.

J-G Sci-8-6 STUDENTS WILL DEMONSTRATE SKILLS AND KNOWLEDGE RELATED TO HEAT:

01. Identify the sun as the primary source of heat energy and list five examples of its uses.

02. Identify and record two examples for each method of heat produced by combustion, friction, compression of gases, collisions of solids, electrical resistance, nuclear energy, and geo-thermal energy.

03. Define the conditions necessary for combustion.

04. Identify dangerous materials that produce spontaneous combustion in the home and explain how they should be stored.

05. Define temperature in terms of molecular motion.

Grade 8

J-G Sci-8-6 STUDENTS WILL DEMONSTRATE SKILLS AND KNOWLEDGE RELATED TO HEAT (continued):

06. Compare the effect of heat on the molecular motion of solids, liquids and gases.

07. Relate the change in phase in an amount of matter to the amount of heat in the matter before and after change of state.

08. Identify and use Celsius and Fahrenheit thermometers and explain how they operate.

09. Define calories and B.T.U.'s.

10. Define specific heat and relate experiments that compare specific heat of several substances.

11. Contrast heat of fusion and heat of vaporization.

12. Compare conduction, convection and radiation as methods of heat transfer.

13. List five good conductors and five good insulators of heat.

14. Distinguish between different heating systems in our homes.

15. Explain the principles involved in the operation of a refrigerator and air-conditioner.

16. Identify three ways to limit heat loss.

17. Present a sample energy audit of their homes.

J-G Sci-8-7 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO LIGHT:

01. List five sources of light energy and conduct or describe an activity to demonstrate each source.

Grade 8

J-G Sci-8-7 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO LIGHT (continued):

02. State the speed of light through a vacuum and a gas.

03. Explain and demonstrate that light travels in straight paths.

04. Distinguish between transparent, translucent, and opaque substances in relation to the amount of light that can pass through.

05. Identify uses of laser light.

06. Define reflection of light and conduct an activity to demonstrate reflection.

07. Compare real images and virtual images and the ways they can be produced.

08. Explain and conduct an activity to demonstrate refraction of light.

09. Use a prism to separate white light into its component colors and explain how frequency and wave length are related to specific colors.

10. Explain how rainbows and oil slicks disperse sunlight.

11. Compare convex and concave lenses and the uses of these lenses to correct vision-problems.

12. Describe the use of lenses in optical instruments.

13. Diagram the eye and explain how each part helps us see.

14. Compare the eye to a camera.

15. Construct a pinhole camera.

16. Describe several lighting methods.

17. Compare incandescent bulbs and fluorescent tubes as to economy and vision.

Grade 8

J-G Sci-8-7 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO LIGHT (continued):

18. Identify the two bands of visible light and list two uses of both.

19. Describe the photoelectric effect and name a device that works on this principle.

20. List the characteristics and uses of X-rays.

21. Explain and read an electric meter.

22. Describe methods for conserving light energy in the home and at school.

J-G Sci-8-8 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO SOUND AND WAVES:

01. Demonstrate that sound is a form of energy produced by vibrating bodies.

02. Diagram, label, and explain parts of a sine wave.

03. Demonstrate the relationship of vibrations to sound production.

04. Demonstrate and diagram compression and rarefaction using simple springs and weights.

05. Compare velocity of sound in various media and temperatures.

06. Compute simple problems in wave propagation.

07. Explain conditions for echoes.

08. Explain the Doppler Effect.

09. Explain the function of the vocal cords, diaphragm, and lips in sound production.

Grade 8

J-G Sci-8-8 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO SOUND AND WAVES (continued):

10. Demonstrate the range of human audibility using an audiometer.

11. Diagram sound reception from outer ear to the brain.

12. Distinguish between the patterns of musical frequencies and the unpatterned sequence of noise.

13. Illustrate the production and transmission of sound in musical instruments.

14. Explain the importance of diaphragms in special uses of sound,e.g., telephones, amplifiers.

15. Identify noise pollution problems and propose possible solutions.

16. Explain the uses of sonar detection.

J-G Sci-8-9 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO MAGNETISM AND ELECTRICITY:

01. Demonstrate that magnets attract materials with an iron content.

02. Diagram the polarity of a magnet.

03. Describe the laws of magnetic attraction and repulsion.

04. Compare permanent, manufactured, and temporary magnetic action.

05. Explain the term north-seeking pole.

06. Locate geographic and magnetic north and south poles on a globe.

Grade 8

J-G Sci-8-9 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO MAGNETISM AND ELECTRICITY (continued):

07. Describe and diagram the magnetic field extending beyond the earth.

08. Demonstrate the application of magnetism, e.g.,doorbells, motors, magnetic tape.

09. Demonstrate some effects of static electricity.

10. Demonstrate and diagram the effect of positive and negative electrical charges on each other.

11. Diagram electric charges on various objects to illustrate attraction and repulsion.

12. Diagram and explain how lightning rods and grounding protect against static electricity.

13. Explain and diagram how free electrons move in a conductor.

14. Explain various methods of generating electricity,e.g., chemical, hydropower, solar, nuclear.

15. Construct at least one model to illustrate the generation of electricity.

16. Distinguish between direct current and alternating current.

17. Diagram distribution of electricity in a city.

18. Diagram and explain an "ideal transformer".

19. Demonstrate fuse action.

20. Explain the advantages of series and parallel circuits.

21. Read an electric meter accurately and compute an electric bill.

Grade 8

J-G Sci-8-9

STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO MAGNETISM AND ELECTRICITY (continued):

22. Compute the cost of electricity used in a day on cost per kilowatt hour from an electric bill.

23. Order a list of home appliances to indicate wattage per hour, per day.

24. Solve simple problems using Ohm's Law.

25. Order a list of metals from lowest to highest resistance.

26. Construct a simple motor and illustrate its use.

27. Distinguish between the function of incandescent and fluorescent bulbs.

28. Explain why transistors have replaced the vacuum tube.

29. List the ways that electrical consumption could be reduced in the home, school, and community.

BIOLOGY
(S-BIO-1)

Key Competencies

S-BIO-1-1 STUDENTS WILL SHOW AN UNDERSTANDING OF THE CONTRIBUTION TO LIFE SCIENCE OF THE EARLY SCIENTISTS:

01. Describe the work of the natural philosophers.

02. Describe the work of the early Greeks and Romans.

a. Galen

b. Aristotle

S-BIO-1-2 STUDENTS WILL SHOW AN UNDERSTANDING OF THE STRUCTURE AND FUNCTION OF THE CELL:

01. Identify contributions of the following scientists to cell studies.

a. Robert Hooke

b. Schleiden and Schwann

c. Von Siebold

02. Explain cell theory.

03. Identify parts of the cell and describe their functions.

04. Explain cell specialization.

S-BIO-1-3 STUDENTS WILL BE ABLE TO USE A MICROSCOPE:

01. Name the parts of the microscope and describe their use.

02. Focus using both high and low power.

S-BIO-1-3 STUDENTS WILL BE ABLE TO USE A MICROSCOPE (continued):

03. Prepare dry and wet mount slides.

04. Approximate sizes of objects being viewed and calculate magnification.

S-BIO-1-4 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF THE CHEMICAL BASIS OF LIFE:

01. Define matter and energy and give examples of each.

02. Give examples of physical and chemical changes.

03. Identify the various forms of energy.

04. List and describe the parts of the atom.

05. Define molecules and explain how atoms form ionic and covalent bonds.

06. Distinguish between organic and inorganic compounds.

07. Explain the function of carbohydrates, proteins, lipids, and nuclear acids.

S-BIO-1-5 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF THE ENERGY TRANSFORMATION THAT TAKES PLACE IN ORGANISMS:

01. Compare and contrast the processes of photosynthesis.

02. Write a simple chemical equation to illustrate photosynthesis.

03. Explain the role of ATP in energy cycles.

04. List the conditions for photosynthesis and describe the light and dark reactions of photosynthesis.

05. Distinguish between cellular respiration and fermentation.

S-BIO-1-6 STUDENTS WILL DEMONSTRATE A KNOWLEDGE OF NUCLEIC ACIDS AND PROTEIN SYNTHESIS:

01. Show the importance of protein synthesis to all life.

02. Show the chemical structure of RNA and DNA.

03. Describe how DNA replicates itself.

04. Describe the importance of the triplet code in DNA.

05. Describe the role of RNA in protein synthesis and the function of proteins in living cells.

S-BIO-1-7 STUDENTS WILL DEMONSTRATE A KNOWLEDGE OF THE CONTINUITY OF LIFE:

01. Explain the nature of cell division and discuss the significance of mitosis.

02. Name and describe the phases of mitosis.

03. Distinguish between sexual and asexual reproduction.

04. Describe the forms of asexual reproduction.

05. Define meiosis and describe its importance to sexual reproduction.

06. List the major differences between meiosis and mitosis.

S-BIO-1-8 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF THE ROLE OF HEREDITY AND ENVIRONMENT IN THE CONTINUITY OF LIFE:

01. Describe Mendel's work with peas.

02. List and explain Mendel's three basic principles.

03. Use punnett squares to show monohybrid and dihybrid crosses.

04. Define genotype, phenotype, homozygous, heterozygous and alleles.

S-BIO-1-8 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF THE ROLE OF HEREDITY AND ENVIRONMENT IN THE CONTINUITY OF LIFE (continued):

05. Show an understanding of Mendel's law of independent assortment and incomplete dominance.

06. Explain sex determination and sex linkage.

07. Describe chromosomal nondisjunction, genelinkage, and cross over.

08. Define population genetics, gene pools.

09. Describe how sex linked traits are inherited and traits such as sickle cell anemia - Tay-Sachs are transmitted from parents to child.

10. Show by example how genetics have produced better quality plants and animals by inbreeding , outbreeding, and selective breeding.

S-BIO-1-9 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF HOW ADAPTATION AND NATURAL SELECTIONS ARE RELATED:

01. Explain the importance of fossil study.

02. Describe Lamarck's explanation of evolution.

03. List the chief factors in Darwin's theory of natural selection.

04. Describe the role of the following evolutionary changes:
    a. Gene mutation
    b. Migration and isolation
    c. Adaptive radiation and convergent evolution

S-BIO-1-10 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF THE ORGANIZATION OF THE LIVING WORLD:

01. Describe the contribution of Carolus Linnaeus.

02. Describe the basis of scientific classification.

03. Explain the binomial nomenclature methods of scientific naming.

04. Name the groupings in the classification systems.

S-BIO-1-11 STUDENTS WILL SHOW AN UNDERSTANDING OF MICROBIOLOGY:

01. Make detailed studies of the following.
    a. Viruses
    b. Bacteria
    c. Algae
    d. Fungi
    e. Protozoa

S-BIO-1-12 STUDENTS WILL SHOW KNOWLEDGE OF THE TREND TOWARD COMPLEXITY AND OVERALL SUCCESS OF THE HIGHER PLANTS:

01. Explain the development of the first land plants.

02. Describe the structure of mosses and ferns.

03. Describe the life cycle of mosses and ferns.

04. List the uses of mosses and ferns.

05. Define a seed plant.

06. List the characteristics of gymnosperms and angiosperms.

07. Distinguish Monocot from Dicot by structural differences.

08. Describe the structure and function of vegetative organs of flowering plants.

09. Describe the structure and function of reproductive organs of a flowering plant.

10. Describe the structure and function of fronds and seeds.

S-BIO-1-13 STUDENTS WILL HAVE KNOWLEDGE OF THE UNITY AND DIVERSITY OF LIFE FOUND IN THE ANIMAL KINGDOM:

01. Demonstrate the advantages and disadvantages of division of labor among cells.
    a. Porifera
    b. Coelenterata
    c. Nematoda
    d. Annelida
    e. Mollusca
    f. Echinodermata
    g. Arthropods

S-BIO-1-13 STUDENTS WILL HAVE KNOWLEDGE OF THE UNITY AND DIVERSITY OF LIFE FOUND IN THE ANIMAL KINGDOM (continued):

02. Characteristics of the chordates.

03. List the structural characteristics and specialized systems of the vertebrates.

04. Compare and contrast the diversity in animals through dissection.

S-BIO-1-14 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF THE SYSTEMS OF DIGESTION, TRANSPORT, AND GAS EXCHANGE:

01. Define diffusion in the following terms:
    a. Independent of substance
    b. Movement is from area of greater to area of lesser concentration
    c. Different substances can be diffusing in opposite directions

02. Explain that when solutions are formed, diffusion stops when material is uniformly dispersed.

03. Explain that cell membrance serves as a barrier to diffusion.

04. Define:
    a. Osmosis
    b. Turgor pressure
    c. Plasmolysis
    d. Active transport

05. Define digestion

06. Differentiate extra cellular from intercellular digestion.

07. Explain the role of enzymes in digestive process and the role of lysosomes in cellular digestion.

08. Compare and contrast digestion in various animal phyla.
    a. Sponge
    b. Coelenterates
    c. Earthworm
    d. Human

S-BIO-1-14 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF THE SYSTEMS OF DIGESTION, TRANSPORT, AND GAS EXCHANGE (continued):

09. Explain digestion in plants and compare it to animals.

10. Compare circulation in various phyla of animals.

11. Describe the transport system in plants and identify function of following tissues

    a. Phloem
    b. Xylem
    c. Vascular rays

12. Compare and contrast respiration in various phyla of animals.

13. Describe gaseous exchange in plants.

S-BIO-1-15 STUDENTS WILL SHOW KNOWLEDGE OF THE INTERRELATIONSHIPS AND THE BALANCES THAT EXIST IN NATURE:

01. Define ecology, ecosystem, and biosphere.

02. Explain interactions in the biotic community.

03. Discuss interaction between biotic community and physical environment.

04. Describe the following cycles:

    a. Water
    b. Carbondioxide oxygen
    c. Nitrogen

05. List the environmental factors that control the changes in a population.

06. Discuss human population growth.

07. Define habitat and niche.

08. Describe food chains.

09. Explain adaptive behavior.

S-BIO-1-16 STUDENTS WILL SHOW KNOWLEDGE OF ENVIRONMENTAL CHANGES THROUGH THE FOLLOWING TASKS:

01. Describe alternating periods of activity in organisms.

02. Explain daily rhythms and seasonal community change.

03. Describe migration.

04. Explain lunar and annual rhythms.

05. Describe natural succession of forests, ponds, and lakes.

06. Describe climatic zones.

07. Name and describe the biomes.

S-BIO-1-17 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF THE LIMITATIONS IMPOSED ON "SPACESHIP EARTH":

01. Explain possible solutions to soil and mineral depletion.

02. Describe water conservation.

03. List effects of water pollution.

04. Discuss recycling of solid waste.

05. Describe causes of air pollution.

06. Define smog.

07. Define fallout.

08. Describe energy problems and list possible sources and solutions.

PHYSICS

(S-Phys-1)

Key Competencies

S-Phys-1-1 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO MOTION AND MEASUREMENT:

01. Name and describe the key metric units of length, mass, and time.

02. Measure length, mass, and time in metric units.

03. Distinguish between velocity and speed, and between vector and scalar quantities.

04. Use graphs and simple algebra to analyze straight line motion.

05. Describe in mathematical and graphical terms the velocity of an airplane when it is flying in one direction and the wind moves in a different direction.

06. Interpret curved motion in terms of changing velocity.

07. Use scientific notation and significant digits correctly.

08. Add and subtract vectors in two-dimensional space.

09. Calculate velocities and distances for objects moving with uniform acceleration.

10. Describe the trajectories of projectiles and the paths of baseballs.

S-Phys-1-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF FORCE AND MOTION:

01. Use the words force, mass, inertia, momentum, and impulse in their correct scientific meaning.

02. Measure mass and weight of various objects in metric units.

03. Discuss weightlessness accurately.

04. Discuss the meaning of a scientific law, theory, and hypothesis.

S-Phys-1-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF FORCE AND MOTION: (continued):

05. Use Newton's second law of motion to define the SI force unit, and to solve problems involving this law.

06. Describe mathematically and graphically what happens when two moving objects bump into each other.

S-Phys-1-3 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF, AND SHOW HOW TO CALCULATE, THE REACTIONS OF FORCES IN EQUILIBRIUM:

01. Determine the resultant and equilibrant of a group of concurrent forces.

02. Apply conditions of equilibrium to the solution of problems.

03. Determine the components of a force.

04. Identify forces and lever arms of forces in concurrent situations.

05. Apply the laws of moments to the solution of problems involving parallel forces.

06. Determine center of gravity for flat objects.

07. Use concept of center of gravity in solution of problems.

S-Phys-1-4 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF PHYSICAL CONCEPTS IN WORK AND ENERGY:

01. Use the words work, power, energy in the proper scientific sense.

02. Solve problems involving these quantities.

03. Measure their own power.

04. Tell about various energy forms, how energy is stored, and how it is changed from one form to another.

05. Explain why objects cannot exceed the velocity of light.

06. Explain how mass is a form of energy and calculate how much.

S-Phys-1-5 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF MOLECULES IN MOTION:

01. Discuss the structure of matter in terms of its being made up of molecules.

02. Use the kinetic molecular theory to explain heat, pressure, and shape.

03. Calculate with reasonable accuracy the size of molecules.

04. Explain such phenomena as crystal shape, surface tension, diffusion, and elasticity.

05. Solve numerical problems involving force, pressure, and area.

06. Predict and explain volume, pressure and temperature relationships in gases.

07. Solve problems involving Boyle's, Charles', and Guy-Lussac's Laws.

08. Explain how a spaceship is able to leave earth and how it can be guided.

09. Explain what keeps the earth moving around the sun and why a car can turn a corner.

S-Phys-1-6 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO THERMAL MEASUREMENTS AND EXPANSION:

01. Use common types of thermometers for temperature measurements.

02. Describe applications of thermal expansion and discuss problems associated with it.

03. Discuss important changes which occur in freezing.

04. Use the units calory and joule correctly in problem solving.

05. Explain the main ideas of the laws of thermodynamics.

06. Solve problems involving mechanical equivalent of heat.

07. Use calorimeters in heat transfer experiments.

08. Solve problems involving specific heat, heat of fusion, heat of evaporation.

S-Phys-1-6 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO THERMAL MEASUREMENTS AND EXPANSION (continued)

09. Provide convincing evidence that there is a coldest temperature and demonstrate at least one way of determining this temperature.

10. Explain the four steps in the cycle of common heat engines.

11. Discuss current energy problems and present potential solutions.

12. Describe the operation of gasoline, Diesel, Wankel rotary, reciprocating steam, and turbine engines.

S-Phys-1-7 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF ELECTRIC CHARGES, FIELDS, AND CURRENTS:

01. Describe the electrical nature and behavior of matter on the basis of experimental evidence observed.

02. Describe electrostatic phenomena in terms of electric fields and their effects on electric charges.

03. Construct electric circuits involving: a d.c. source, one or more loads in series and parallel, a switch, and a fusing device.

04. Describe various electric circuits in terms of electron flow and transfer of energy.

05. Use schematic diagrams and symbols to describe electric circuits.

06. Describe what happens when electric currents flow in a solid, a liquid, or a gas.

07. Use an electroscope to detect fundamental electric charges.

08. Define volt, ampere, coulomb, and ohm in terms which are precise and fundamental.

S-Phys-1-8 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF MAGNETS AND MAGNETIC FIELDS:

01. Use the law of magnets to explain simple situations involving permanent magnets, electromagnets, and earth magnetism.

S-Phys-1-8 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF MAGNETS AND AND MAGNETIC FIELDS (continued):

02. Distinguish between magnetized and unmagnetized substances, and identify magnetic poles.

03. Make permanent magnets and electromagnets.

04. Demonstrate magnetic fields.

05. Explain ferromagnetism in terms of domain theory.

06. Predict, and experimentally verify, direction and strength of magnetic fields near current-carrying wires or loops of wire.

07. Explain and demonstrate the phenomena of paramagnetism and diamagnetism.

08. Use a compass to determine direction including compensating for magnetic declination.

S-Phys-1-9 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF DIRECT AND ALTERNATING CURRENT:

01. Explain why current flows in complete electrical circuits.

02. Calculate resistance and predict behavior of circuits containing resistances in series and parallel.

03. Connect lamps and other electrical devices in series and parallel circuits and control operations.

04. Use ammeters and voltmeters properly in circuits.

05. Use Ohm's Law to calculate current, voltage and resistance of circuits.

06. Use Kirchhoff's rules to analyze electric circuits.

07. Calculate power and energy delivered in circuits.

08. Describe relationship among peak, average, and rms values of voltage and current in alternating current circuits.

S-Phys-1-10 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF MOVING CHARGES IN MAGNETIC FIELDS:

01. Use simple apparatus to demonstrate motor and generator effects.

02. Predict direction and magnitude of induced emf.

03. State Lenz's Law and illustrate how it applies to motors, generators, inductors.

04. Use and explain a transformer in circuits.

05. Calculate input and output voltage, current, and power for transformers.

06. Calculate inductive reactance of inductors with known inductance.

S-Phys-1-11 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF REFLECTION AND REFRACTION OF LIGHT:

01. Use diagram to show the path of rays of light reflected from plane of curved surface.

02. Use diagram to describe images formed by plane, concave, and convex mirrors.

03. Explain meaning of spherical abberation and how it can be overcome.

04. Describe and measure units of luminous intensity, luminous flux and illumination.

05. Use the law of illumination in solving problems and explaining some principles of astronomy.

06. Compare efficiencies of various lamps.

07. Describe and explain refraction of light.

08. Use equations to define index of refraction, to measure the index, and to predict paths of refracted light rays.

09. Use diagrams to locate and describe images formed by converging and diverging lenses.

10. Describe and explain total internal reflection and use Snell's Law to calculate critical angle.

11. Describe optics of human eye, camera, projector, telescope, and microscope.

S-Phys-1-12 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF WAVES AND SOUND:

01. Describe how waves are created and how they transfer energy.

02. Discuss meaning and relationship of wavelength, frequency, period, amplitude, displacement, phase, reflection, refraction, interference.

03. Distinguish between longitudinal and transverse waves.

04. Explain Doppler effect and describe situations in which it occurs.

05. Use Huygens' principle to predict wave behavior.

06. Demonstrate and explain standing waves.

07. Demonstrate that sound is transmitted by waves.

08. Describe behavior of strings and of columns of air as they produce sound.

09. Discuss the characteristics of music.

S-Phys-1-13 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF THE WAVE NATURE OF LIGHT:

01. Show experimentally that light waves diffract and interfere.

02. Explain how accurate measurements of the speed of light have been made.

03. Show and explain the polarization of light.

04. Measure wavelength and frequency of color.

05. List and describe the various kinds of waves in the electromagnetic spectrum.

06. Use prisms and gratings to form spectrums.

07. Describe and explain three types of emission spectra.

08. Describe and explain absorption spectra.

09. Demonstrate how spectra can be used to tell temperature, to determine speed and direction of stars, and for chemical analysis.

S-Phys-1-13 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF THE WAVE NATURE OF LIGHT (continued):

10. Show how mixtures of pigments and light produce new colors.

11. Use the three-color hypothesis to explain how people see color and afterimages.

12. Explain color television.

S-Phys-1-14 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF ELECTRONS AND QUANTUM THEORY:

01. Demonstrate how cathode rays are produced and explain their behavior.

02. Discuss discovery of the electron and show how its mass and charge are measured.

03. Describe experiments showing structure of the atom.

04. Explain how isotopes are separated and explain their properties.

05. Describe structure of atoms given atomic number and mass.

06. Discuss how quantum theory explains photo-emission.

07. Explain the Bohr atom and recent modifications of this theory.

08. Demonstrate and explain ionization of mercury and operation of lasers based on quantum theory.

09. Explain how light and electrons behave both as particles and waves.

10. Tell how natural radioactivity was discovered and led to the discovery of two new elements.

11. Write equations describing nuclear reactions.

12. Define half-life of a nuclide.

13. Explain mathematically the discovery of the neutron and artifical radioactivity.

14. Use and explain Geiger-Muller counters and cloud chambers.

S-Phys-1-14 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF ELECTRONS AND QUANTUM THEORY (continued):

15. Describe various ways in which radioactive materials are used.

16. Explain antimatter, quarks, quasars, neutron stars, black holes.

17. Explain how fission and fusion reactions produce energy.

S-Phys-1-15 STUDENTS WILL DEMONSTRATE A KNOWLEDGE OF ELECTRONICS AND EXHIBIT SKILLS IN ITS USE:

01. Explain how current flows in neon-type and fluorescent lamps, and how each produces light.

02. Identify and describe two methods of readouts on calculators.

03. Explain thermionic emission in terms of atomic forces, free electrons, and work function.

04. Explain and demonstrate the action of a diode.

05. Demonstrate the action of filters on rectifier circuits.

06. Use an oscilloscope in examining the shape, frequency, and amplitude of fluctuating wave forms.

07. Describe and explain the action of a classroom Van de Graaff generator.

08. Discuss and mathematically explain the operation of a cyclotron or other high energy accelerator.

09. Explain why accelerators need carefully controlled magnetic fields and what new learnings are coming from them.

10. Explain how solid state diodes function and use these in practical circuits.

11. Develop sketches to show how crystals of silicon or germanium function as N-type, PNP type, semiconductors.

12. Use transistors, inductors, and capacitors to develop resonant circuits and amplifier circuits.

S-Phys-1-15 STUDENTS WILL DEMONSTRATE A KNOWLEDGE OF ELECTRONICS AND EXHIBIT SKILLS IN ITS USE (continued):

13. Explain the operation of microcircuits and integrated circuits.

14. Explain how microprocessors are currently used and develop strategies for how they may be used in the future.

CHEMISTRY

(S-Chem-1)

Key Competencies

S-Chem-1-1 STUDENTS WILL UNDERSTAND THE BASIC RELATIONSHIP OF CHEMISTRY TO THE STRUCTURE OF MATTER:

01. Illustrate chemistry as a science, separate and distinct, yet intertwined with all other science.

02. Describe chemistry as it deals with matter, its composition, and the changes it undergoes.

03. Identify properties we arbitrarily designate as physical or chemical.

04. Show how suggested ideas lead to new principles.

05. Explain types of vocations available in area of chemistry.

06. Explain how established principles lead to prediction of behavior.

S-Chem-1-2 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF THE NATURE OF MATTER:

01. Identify the following scientists' contributions to the Atomic discoveries:

a. Dalton
b. Becquerel and the Curies
c. Thompson
d. Millikan
e. Rutherford
f. Mosley
g. Bohr

02. Identify three basic particles of atom.

03. Define atomic number, atomic weight, isotopes.

04. Show Octet theory and Lewis dot diagrams for first 20 elements.

S-Chem-1-2 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF THE NATURE OF MATTER (continued):

05. Explain valence and valence electron relationship.

06. Demonstrate arrangement of electrons in energy levels and periodicity.

07. Identify types of bonding:

a. Ionic
b. Covalent
c. Polar
d. Metallic

S-Chem-1-3 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF FORMULAS AND EQUATIONS:

01. Recite rules for naming simple compounds.

02. Calculate atomic weight and formula weight.

03. Demonstrate knowledge of mole, mole weight, mole volume.

04. Write equations.

05. Balance simple equations.

06. Balance equations of following type:

a. Analysis
b. Synthesis
c. Single replacement
d. Double replacement

S-Chem-1-4 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF THE ELEMENT, OXYGEN:

01. Describe the physical and chemical properties of oxygen.

02. Prepare oxygen in the laboratory by two methods.

S-Chem-1-4 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF THE ELEMENT, OXYGEN (continued):

03. Explain the commercial preparation of oxygen.

04. Describe the reation of oxides with water and understand their properties.

05. Describe respiration, combustion, and other uses of oxygen.

06. Describe allotropic elements and relate their properties, preparation, and uses to ozone.

S-Chem-1-5 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF THE ELEMENT, HYDROGEN:

01. Describe how hydrogen is the basic building block of all elements and the most abundant element.

02. Describe the physical and chemical properties of hydrogen.

03. Prepare hydrogen in the laboratory.

04. Show an understanding regarding the commercial preparations of hydrogen.

05. Measure the activity of metals by the replacement rate of hydrogen.

06. Demonstrate an understanding of oxidation reduction reactions and balance equations using oxidation reduction.

07. Show an understanding of uses of hydrogen as a fuel, reducing agent in the hydrogenation of of oils, nuclear fusion.

S-Chem-1-6 STUDENTS WILL BE ABLE TO DEMONSTRATE THEIR KNOWLEDGE OF THE GASEOUS PHASE OF MATTER:

01. Show an understanding regarding random motion and constant elastic collisons.

02. Show an understanding that the temperature of a gas is a measure of its kinetic energy.

S-Chem-1-6 STUDENTS WILL BE ABLE TO DEMONSTRATE THEIR KNOWLEDGE OF THE GASEOUS PHASE OF MATTER (continued):

03. Demonstrate a knowledge of the effect of molecular collisions on pressure exerted by gases.

04. Demonstrate an understanding of effect of temperature on volume of gases.

05. Solve problems using Charles' Law.

06. Demonstrate an understanding of the effect of pressure on the volume of gases.

07. Solve problems using Boyle's Law.

08. Demonstrate a knowledge of standard temperature and pressure and be able to convert using combined gas laws, temperature, pressure, and volume.

09. Establish what a molar volume is.

10. Establish Avogadro number and use mole values in various types of problems.

S-Chem-1-7 STUDENTS WILL DEMONSTRATE A KNOWLEDGE OF THE LIQUID AND SOLID STATE:

01. Distinguish liquids by their properties:

    a. Definite volume
    b. Fluidity
    c. Diffusion
    d. Evaporation
    e. Kinetic theory

02. Solve problems in specific density using water as a standard.

03. Solve problems using vapor pressure of liquids.

04. Show an understanding regarding change of state:

    a. Boiling point
    b. Heat of vaporization
    c. Condensation

S-Chem-1-7 STUDENTS WILL DEMONSTRATE A KNOWLEDGE OF THE LIQUID AND SOLID STATE (continued):

05. Distinguish solids by their properties:

a. Definite shape and volume
b. Diffusion

06. Show understanding of conditions for change of state:

a. Melting and freezing points
b. Heat of fusion

07. Recognize structure of solids:

a. Amorphous
b. Crystalline

08. Calculate and prepare solutions from solid crystals.

S-Chem-1-8 STUDENTS WILL DEMONSTRATE A KNOWLEDGE OF SOLUTION CHEMISTRY:

01. Describe the properties of solutions.

02. Recognize by content of solute, types of solutions.

03. Identify the following solutions:

a. Dilute
b. Concentrate
c. Saturated
d. Supersaturated

04. Demonstrate the factors affecting solubility:

a. Effect of heat
b. Effect of pressure
c. Agitation
d. Particle size
e. Hydrogen bonding

05. Express concentration of solutions:

a. Molar solutions
b. Normal solutions and equivalent weight
c. Molal solutions

S-Chem-1-9 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF IONIZATION:

01. Explain ions are electrically charged atoms or groups of atoms.

02. Write and balance ionic equations and understand that ionic equations more accurately demonstrate what happens in solution reactions than chemical equations.

03. Calculate freezing point and boiling point changes due to ionization in solution.

04. Show how and why electrolytes are used in industry.

S-Chem-1-10 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF ACID BASE:

01. Identify the hydronium ion as a hydrated proton.

02. Identify acids as substances that release or donate protons to other substances.

03. Explain how the degree of Ionization of the hydronium ion determines the strength of acid.

04. Use the following properties to identify acids:

    a. Hydrogen releasing
    b. Conductivity
    c. Indicator changes
    d. Taste

05. Show understanding that oxides are acid anhydrides.

06. Show an understanding of the uses of these common acids:

    a. Sulfuric
    b. Hydrochloric
    c. Nitric
    d. Phosphoric and acetic

07. Identify bases as proton acceptors.

S-Chem-1-10 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF ACID BASE (continued):

08. Use the following properties to identify bases:

    a. Electrical conductivity
    b. Reaction with acid
    c. Indicator changes
    d. Taste
    e. Fuel

09. Show an understanding of what oxides are basic anhydrides.

10. Explain the uses of bases.

    a. Sodium hydroxide
    b. Calcium hydroxide

11. Calculate pH^+ from ionization rates.

S-Chem-1-11 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF CHEMICAL EQUILIBRIUM:

01. Explain how a state of equilibrium is attained when opposing reactions occur simultaneously and at equal speed.

02. Explain how the law of mass action is concerned with the relationship between the speed of a reaction and the concentration of the reactants.

03. Explain how the equilibrium constant is the ratio of the product of the concentration of the reactants to the product of the concentration of the substances.

04. State Le Chatelier's principle that an equilibrium shifts when subjected to stress caused by:

    a. Change in concentration
    b. Change in temperature
    c. Change in pressure

05. Explain conditions that cause a reaction to go to completion.

06. Explain the application of the common ion effect to the Law of Mass Action

S-Chem-1-11 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF CHEMICAL EQUILIBRIUM(continued):

07. Explain hydrolysis.

S-Chem-1-12 STUDENTS WILL DEMONSTRATE AN UNDERSTANDING OF OXIDATION REDUCTION:

01. Show understanding that oxidation is the loss of electrons, and reduction is the gain of electrons.

02. Show understanding that spontaneous oxidation-reduction reactions are used as a source of electric energy in electro-chemical cells.

03. Show understanding that oxidation number indicates a substance's state of oxidation.

04. Balance oxidation reduction equations by electron gain and loss.

S-Chem-1-13 STUDENTS WILL EXPLORE THE CHEMICAL FAMILIES THROUGH A SERIES OF LABORATORY EXPERIMENTS TO DISCOVER THE VARIOUS CHEMICAL FAMILIES:

01. Investigate the halogens:

a. The high electro negativity of the halogen family determines many of their chemical properties.
b. Physical properties of halogens are a periodic function of their total structure.
c. Use a halogen in home and industry.

02. Investigate sulfur and its compounds:

a. Allotropic forms of sulfur.
b. Use of hydrosulfuric acid in chemical analysis for metal ions.
c. Sulfur dioxide as a major pollutant.
d. Laboratory and industrial use of sulfuric acid.

03. Investigate nitrogen and phosphorus:

a. Nitrogen is a major component of air.
b. Uses of ammonium in industrial and biological reactions.

S-Chem-1-13 STUDENTS WILL EXPLORE THE CHEMICAL FAMILIES THROUGH A SERIES OF LABORATORY EXPERIMENTS TO DISCOVER THE VARIOUS CHEMICAL FAMILIES(continued):

c. Nitric acid is unstable and an excellent oxidizing agent.
d. Nitric acid as a test for protein.
e. Nitrous oxide is a commonly used anaesthetic.
f. Phosphorus is present in two allotropic forms.

04. Investigate carbon:

a. Carbon exists in allotropic forms.
b. Carbon allotropes have wide uses in industry and home.
c. Carbon dioxide is an important gas in nature and a product of air respiration.

05. Investigate the metals:

a. Group 1 elements in addition to being strong ionic compounds will form hydroxides that are strongly basic.
b. Ca^{++} and Mg^{++} ions in water are responsible for hardness.
c. $Al(OH)_3$ is useful as a coagulant and mordant.
d. Metals are reduced industrially by the termite reaction.
e. Magnesium and aluminium are important light metals with many uses in the home and industry.
f. Annealing and hardening of steel are treatments to restore flexibility and toughness.
g. Alloying metals with one or more other metals provides resistance to hard wear, high temperatures, and corrosion.

S-Chem-1-14 STUDENTS WILL BE ABLE TO PERFORM THE FOLLOWING TASKS IN QUALITATIVE CHEMICAL ANALYSIS:

01. Identify ions usually in solution.

02. Test for Pb^{++}, Ag^{+}, Hg^{+}.

03. Perform cobalt nitrate tests.

S-Chem-1-14 STUDENTS WILL BE ABLE TO PERFORM THE FOLLOWING TASKS IN QUALITATIVE CHEMICAL ANALYSIS(continued):

04. Perform flame tests.

05. Identify unknown cations.

06. Identify unknown anions.

S-Chem-1-15 STUDENTS WILL BE ABLE TO PERFORM THE FOLLOWING TASKS IN RELATION TO ORGANIC COMPOUNDS:

01. Demonstrate understanding that the great number and variety of organic compounds is due to covalent carbon bonding.

02. Identify compounds in following hydrocarbon series:

a. Alkanes
b. Alkenes
c. Alkynes
d. Aromatic

03. Write addition and substitution reactions.

04. Identify by functional group the following:

a. Alcohols
b. Ethers
c. Aldehydes
d. Ketones
e. Organic acids
f. Esters

05. Do polymerization reactions.

S-Chem-1-16 STUDENTS WILL BE ABLE TO PERFORM THE FOLLOWING TASKS IN RELATION TO RADIOCHEMISTRY:

01. Discuss the contribution of the following scientists in the development of the theory:

a. Roentgen
b. Becquerel
c. Pierre and Marie Curie
d. Crookes
e. Rutherford

S-Chem-1-16 STUDENTS WILL BE ABLE TO PERFORM THE FOLLOWING TASKS IN RELATION TO RADIOCHEMISTRY(continued):

02. Show an understanding regarding the nature and measurement of radioactivity:

    a. Alpha, beta, and gamma rays.
    b. Transmutation and radioactive decomposition.
    c. Half-life.

03. Discuss nuclear stability:

    a. Binding energy.
    b. Neutron to proton energy.

04. Discuss artificial radioactivity:

    a. Nuclear disintegration.
    b. Fission
    c. Fusion

05. Discuss uses of fission and fusion.

06. Demonstrate a knowledge of environmental implications.